SECRET

October 3, 1955

CMCC Doc. No. 151.700
Copy / of 2
Page 1 of 1

Dear Dick:

We are forwarding herewith five copies of Monthly Progress Report No. 4 covering the work performed on System No. 3 during the period extending from 4 August 1955 to 4 September 1955. Progress on this program continues to be excellent.

Several revisions of basic importance to System No. 2 are in process at this time, and I hope that some of the problems which have plagued us up to the present time can now be resolved in a favorable sense. Accordingly, the progress report now due on System No. 2 is being withheld to permit incorporation of some of the latest advances made toward a solution of the navigation problem. We will make every effort to have a revised report in your hands at the earliest date possible.

Sincerely,

Burt

Burt

Enclosures:
CMCC Doc. No. 163.2013
Copies 1-5 of 7

SECRET

SECRET

SAPC-2066
cy 1 of 5

Monthly Progress Report No. 4

System No. 3

Contract No. A-101

4 August 1955 to 4 September 1955

CMCC Document No. 163.2013

Copy 1 of 7

This document contains information affecting the National Defense of the United States within the meaning of the Espionage Laws, Title 18, U. S. C., Sections 793 and 794. Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.

SECRET

TABLE OF CONTENTS

Paragraph		Page
1-0.	Introduction	1
2-0.	Antenna	1
3-0.	R-F Assembly	2
4-0.	I-F Assembly	2
5-0.	Second Local-Oscillator Assembly	3
6-0.	Third Local-Oscillator Assembly	3
7-0.	Playback Unit	4
8-0.	Test Unit	5
9-0.	Receiver Packaging	5
10-0.	Summary and Planning	5

APPENDED FIGURES

Figure		Page
Figure 1.	Sketch of Antenna Model	6
Figure 2.	Antenna Radiation Power Pattern	7
Figure 3.	Playback Unit Circuitry	8

1-0. INTRODUCTION.

25X1D [redacted]

25X1D [redacted] The detailed design requirements, as well as an outline of the proposed design which meets these requirements, appear in the Technical Exhibit of the System No. 3 Proposal.

1-2. Prior to the present report period, the basic system design had been completed and the design and construction of the system components had begun. Progress in the basic design and construction of the system components are described in previous monthly letter reports. During the period covered by this report, work has continued on the detailed design and construction of the components comprising the first breadboard model of the system. Progress in design and construction of the system components achieved during this period are described in the following paragraphs.

2-0. ANTENNA.

2-1. Preliminary pattern measurements have been made on a 20:1 scale model of an airplane with a flush antenna mounted in place. As indicated in figure 1, this antenna consists of a U-shaped slot cut out of the metal skin of the nose section of the airplane. In the actual installation, the slot will be covered with a dielectric sheet set flush with the airplane skin. The slot field produces a vertical polarization sensitivity, while horizontal currents on the skin provide horizontal polarization response. It was anticipated that the vertical polarization component would predominate, and test results bore this out. Figure 2 shows the measured polarization patterns obtained from the antenna of figure 1. Measurements

25X1D [redacted]

2-2. In order to improve the relative response of the antenna to horizontally polarized waves, the tongue of the antenna was made narrower, and in fact, reduced to a wire. This was done to reduce the area of the electric field aperture which produces the vertical polarization response, and to concentrate and further expose to space the electric currents which produce the horizontal polarization response. One might expect that the radiation pattern of an antenna having this configuration would be similar to the radiation pattern of a parallel wire transmission line in which, theoretically, there would be practically no radiation response transverse to the transmission line (i.e., no vertical polarization). Measurements of the horizontal and vertical response of the modified antenna, however, showed that the vertical response (the slot field) still far exceeded the horizontal response (the field due to the electric current), and the response patterns obtained showed only a small improvement of the relative response of the antenna to horizontally polarized waves. Further pattern measurements of an exploratory nature were also made with other minor changes in tongue configurations. Although the results of these and the preceding measurements have been negative in terms of a final acceptable design, there has been revealed important information upon which future design may be based, particularly in regard to the experimental information that shows the extent to which the slot field influences the antenna response. Changes in antenna configuration, based on these measurements, are presently being made.

2-3. A half-scale model of the nose section of an airplane has been constructed in the form of a wooden framework covered with copper screening. Measurements using this half-scale model, will begin during the next report period.

3-0. R-F ASSEMBLY.

25X1D

3-1. The wide-band preamplifier which will be used as the input stage of the receiver has been built and tested. This amplifier has a bandwidth extending from [redacted] and includes a type 6299 planar triode in a circuit which also incorporates a two-section constant-K band-pass filter in the plate circuit. The filter provides 40 db of attenuation at about 25 megacycles outside both ends of the passband. These band-pass characteristics are intended to improve image rejection.

3-2. The r-f head for the lowest frequency channel and the preamplifier were tested as a unit with reasonably successful results. A set of crystals for the first local oscillator which is contained in each r-f head has been ordered. These crystals operate on their 7th and 9th mechanical overtones and thus eliminate the need for frequency-doubling circuits. This technique greatly reduces the generation of undesired signals. The design of the r-f assembly will be completed when these new crystals are incorporated.

3-3. The commutator, which performs the gating of the r-f heads, has been completed and will be tested in conjunction with the r-f assembly.

4-0. I-F ASSEMBLY.

4-1. The i-f assembly which was subcontracted to the RS Electronics Corporation was received and tested. It was found necessary to make a number of modifications to the original design. When these modifications were completed, the gain, stability, and agc were found to be satisfactory. A 10-microvolt signal at the input of the assembly produces the four-volts delay threshhold at the agc detector. The agc then limits the output to a rise of 6 db while the input is further increased by 80 db.

4-2. The assembly is now sufficiently stable to operate without any supplementary shielding. This represents some factor of safety since the unit will finally be housed in its own shielded compartment. The next step in the test procedure is to combine the i-f assembly with the associated assemblies to check the combined operation. A test jig is being constructed to accommodate the various plug-in assemblies and to provide convenient test points.

5-0. SECOND LOCAL-OSCILLATOR ASSEMBLY. The multi-frequency crystal-controlled oscillator has been rebuilt in its final breadboard form and incorporates the subminiature crystals recently received from the manufacturer. A printed board for the diode matrix which performs the gating of the crystals has been fabricated and the final breadboard of the electronic commutator has been built. This commutator comprises the diode matrix and the flip-flop counters which control the matrix. The use of crystal diodes and silicon transistors throughout has resulted in a very compact unit. Tests are about to begin on the combined operation of the oscillator and the commutator. Temperature tests will be included.

6-0. THIRD LOCAL-OSCILLATOR ASSEMBLY.

6-1. Although the basic design of the third local-oscillator assembly has been completed, this assembly is being modified in order to improve its characteristics. The design of the reactance tube and oscillator have been changed to obtain a greater linear operating range. The design of playback equipment can be greatly simplified if a calibration system does not have to be incorporated (i.e., if the frequency is a linear function of time). Accordingly, the reactance-tube characteristic was re-examined for linearity and found to be approximately parabolic over the entire frequency range. However, about one-half of the range can be used without introducing an error greater than 10 kc. The effective capacitance of the reactance tube was therefore increased to provide a total frequency deviation of about 800 kc, the mid-portion of which is used to obtain the required 350 kc with reasonable linearity. This modification resulted in additional losses in the oscillator tank since the reactance-tube losses are more tightly coupled to the tank circuit. A proportionately greater sensitivity to temperature and supply-voltage fluctuations must therefore be expected.

6-2. A few minor circuit changes were required in the oscillator to accommodate the extended reactance-tube range. When these were made, the incidental amplitude modulation was somewhat larger and the rms tank voltage varied from 9.0 to 13.0 volts over the 350-kc range. The electron-coupled output, however, operates well saturated, with the result that the output varies only between 14.0 and 14.5 volts over the same range.

6-3. Temperature drift has been partly compensated for by the use of a silvered-mica capacitor, having a positive temperature coefficient, as a portion of the tank capacitance. The use of this capacitor appears to be adequate for slow temperature changes in which the circuit is always in thermal equilibrium. When parts of the circuit are heated or cooled relative to other parts, larger effects are noted. No suitable means for evaluation of these effects in terms of ultimate performance can be devised at present, but it appears unlikely that large unresolved temperature differences would occur. A copper baseplate has been used to facilitate equilibrium conditions.

6-4. The sweep circuit which controls the oscillator has undergone some change because it has been found that the leakage between sections of dual triodes caused the sweep capacitor to charge and discharge improperly. A complete survey of the several possible combinations has been made to determine the optimum distribution of tube functions among the tube envelopes.

7-0. PLAYBACK UNIT.

7-1. Although much of the circuitry of the playback system is well into the development stage some parts of the system design are still under study. The portion of the circuitry whose design is complete except for minor details is the pulse separator. The pulse separator performs the initial step in the conversion of the coded frequency and time information to a form suitable for presentation on decimal counters. Specifically, the pulse separator separates frequency code pulses, timing tones, and audio messages, and converts the code pulses to binary numbers. The magnitude of circuitry involved is indicated in block diagram figure 3. A detailed description of the circuits represented by the blocks of this diagram will appear in the final engineering report.

7-2. The second part of the electronic circuitry of the playback unit is the computer. These circuits transform the binary number information from the pulse separator to indications of frequency and time, and in addition, provide an output which can be used to operate a visual printer or other recording device. Originally, some thought was given to the possibility of subcontracting this unit. However, exploratory discussions with the Berkeley

Division of Beckman Instruments Corporation indicated that we should undertake to develop and build this unit ourselves. Accordingly, experimental work has been started on this unit.

7-3. The design of a test-function generator is also is progress. This unit generates a signal which simulates the input to the pulse separator and computer, and will be used to test these units. Construction of this test unit will be completed within the next two weeks.

7-4. The design of the magnetic tape playback mechanism for the playback unit has been started. This device is required to start or stop within 10 milliseconds while handling the special 0.5-mil recording tape used in the airborne recorder. The tape reels will be controlled by a commercially available servo system and a jam-roller and head assembly which will be designed.

8-0. TEST UNIT. The design of the test unit has been modified so that a more complete test procedure, than was originally envisioned, will be possible. Construction is continuing on this unit.

9-0. RECEIVER PACKAGING.

9-1. Drawings have been completed for the case which houses the receiver and its fabrication has begun. This case is divided into shielded compartments into which the various assemblies will be inserted by means of a plug-in construction.

9-2. Experimental studies have been conducted on the thermal conditions to be expected. On the basis of these studies, the decision has been made to rely upon conduction cooling in the final unit. This will result in considerable saving of weight as compared to forced air cooling in which a blower, ducting, and a more complex case mounting would be required. It should be mentioned that, although normal operation would use conduction cooling, supplementary forced air cooling would be provided during pre-flight testing.

10-0. SUMMARY AND PLANNING. The final circuit design of all system components has been established. Minor modifications can be expected but it appears unlikely that any major redesign will be required. The construction of first breadboard models of all subassemblies are nearing completion. Construction is expected to continue for several more weeks after which time system testing of the breadboard model of the airborne receiver unit will begin. This will be followed directly with component redesign for the prototype unit.

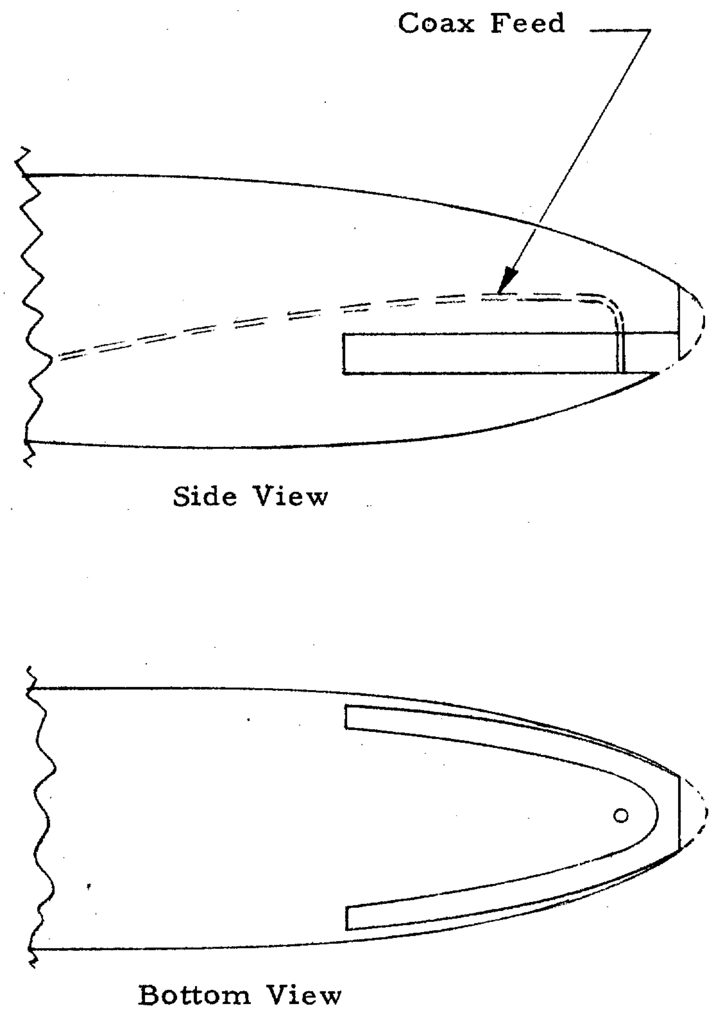

Figure 1. Sketch of Antenna Model

25X1D

SECRET

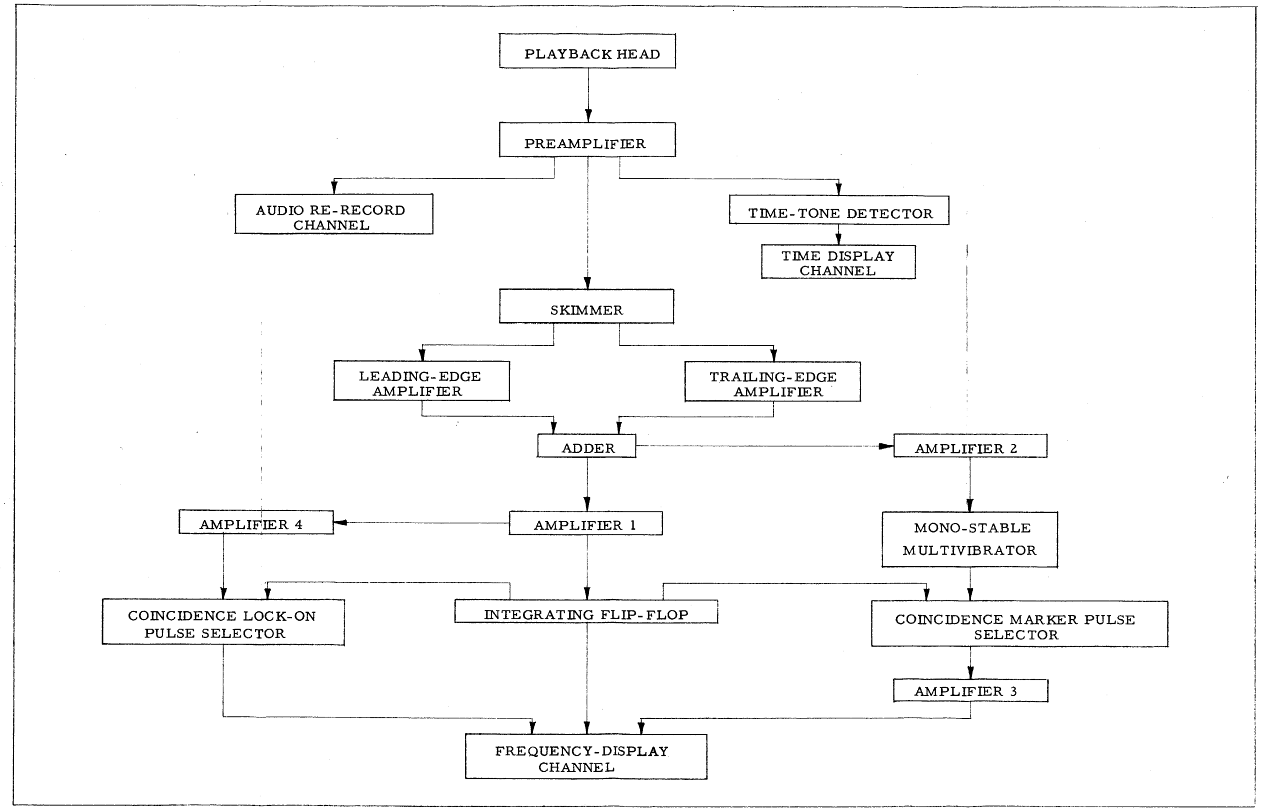

Figure 3. Playback Unit Circuitry

SECRET

50699015

CMCC NO. 241.326 - COPY 1